REMARKS

In view of above amendments and following remarks, reconsideration and further examination are requested.

In Section 4 on page 2 of the Office Action, the Examiner objected to claim 6 as being dependent upon a rejected base claim, but indicated that this claim would be allowable if rewritten in independent form including all the limitations of the base claim and any intervening claims. Accordingly, by the current Amendment, claim 6 has been rewritten in independent form, whereby this claim along with its dependent claims, should now be allowed by the Examiner.

The instant invention pertains to a polishing apparatus for polishing a workpiece, wherein the polishing apparatus comprises a polishing table having a polishing surface, a top ring for holding a workpiece and pressing the workpiece against the polishing surface, a dresser for dressing the polishing surface, and a sensor for observing a property of the polishing surface while the polishing surface is being dressed by the dresser. The sensor is mounted on the dresser. Because the sensor is mounted on the dresser, the property of the polishing surface can be observed by the sensor simultaneously with dressing of the polishing surface such that adjustments in the dressing operation can be quickly made. Also, because the sensor is mounted on the dresser, the position of the sensor can easily be adjusted with respect to the polishing surface such that it is easy to adjust the sensor to an optimum position for measuring the property of the polishing surface.

Claim 1 is representative of this invention.

The Examiner has rejected claims 1-5 under 35 U.S.C. § 102(e) as being anticipated by Hayakawa et al. This rejection is respectfully traversed for the following reasons.

With reference to Figure 6, Hayakawa et al. discloses a polishing device that comprises a polishing plate 1 having a polishing pad 2 thereon, wherein the polishing pad 2 provides a polishing surface 2a. The device also comprises a polishing head 4 and a displacement sensor 26, each of which is mounted on the column 23.

During operation of the device, the column 23 is rotated such that the polishing head 4 faces the polishing surface 2a of the polishing pad 2 that is mounted on the polishing plate 1. After

polishing of a substrate, the substrate is removed from the polishing head 4. Then, the column 23 is rotated to retract the polishing head 4 such that the polishing head 4 no longer faces the polishing surface 2a, and subsequently the displacement sensor 26 is positioned to face the pad surface 2a. Then, the column 23 is moved in a radial direction of the polishing plate 1 such that the displacement sensor 26 is moved from a peripheral portion of the polishing pad 2 toward a central portion thereof. During this time, the profile of the pad surface 2a is determined and displayed by an XY recorder 27.

In rejecting claims 1-5, the Examiner expressed that Hayakawa et al. discloses a polishing table 2, a top ring 4a, a dresser 15, a sensor 26 and a display device 27. However, the only embodiment of Hayakawa et al. that discloses a sensor is the embodiment represented by Figure 6, which embodiment does not expressly disclose that a dresser is also part of the device.

The embodiment that discloses the dresser 15a is the second embodiment disclosed by Hayakawa et al., i.e. the embodiment as depicted by Figures 4 and 5. However, this embodiment does not disclose any sensor.

Accordingly, there is no single embodiment of Hayakawa et al. that expressly discloses each of a polishing table, a top ring, a dresser and a sensor. Because of this, claim 1 is not anticipated by Hayakawa et al., and accordingly, it is respectfully submitted that the 35 U.S.C. § 102(e) rejection should be withdrawn.

Assuming arguendo that Hayakawa et al. can be said to teach or suggest a polishing apparatus comprising a polishing table, a top ring, a dresser and a sensor, claim 1 would still be allowable over Hayakawa et al.

In this regard, claim 1 recites that the sensor is for observing a property of the polishing surface **while said polishing surface is being dressed by said dresser**. This limitation is not taught or suggested by Hayakawa et al. Specifically, as alluded to previously, the only sensor in Hayakawa et al. is sensor 26 which is used in an embodiment that does not include a dresser and does not observe a property of the polishing surface while any other operation is being performed. That is, as expressed in column 10, lines 25-35, the profile of the pad surface 2a is determined **after** the polishing operation has been completed. Also, because this embodiment does not disclose a dresser, the profile of the pad surface 2a is **not** determined while the polishing surface is being dressed.

Accordingly, for this additional reason, claim 1 is not anticipated by, and is allowable over, Hayakawa et al.

Furthermore, amended claim 1 now further recites that the sensor is **mounted on said dresser**. This limitation is clearly not disclosed by Hayakawa et al. because in the embodiment that discloses the sensor 26, there is no dresser disclosed. Accordingly, the sensor 26 is not mounted on a dresser. For this additional reason, claim 1 is not anticipated by, and is allowable over, Hayakawa et al.

Furthermore, assuming arguendo that one having ordinary skill in the art would have found it obvious to provide a dresser in the embodiment as depicted in Figure 6, there would have been no teaching or suggestion to have mounted the sensor 26 on this dresser, since the mounting of the sensor 26 on the column 23 allows the device of Hayakawa et al. to operate as intended.

Indeed, were a dresser provided in the embodiment as depicted in Figure 6, it would appear as though the dresser would be mounted to the column 23 in a manner similar to that by which the polishing head 4 is mounted to the column 23, such that the positional relationship between the dresser and the sensor would be similar to that between the polishing head and the sensor. In any event, the sensor would not be mounted on the dresser. Thus, claim 1 is allowable over Hayakawa et al.

Furthermore, with regard to claim 4, this claim recites that the sensor is **vertically movable independently of said top ring or said dresser**. The sensor 26 of Hayakawa et al. is not shown to be vertically movable relative to polishing head 4 or any dresser. Accordingly, claim 4 is patentable in its own right.

In view of the above amendments and remarks, it is respectfully submitted that the present application is in condition for allowance and an early Notice of Allowance is earnestly solicited.

If after reviewing this Amendment, the Examiner believes that any issues remain which must be resolved before the application can be passed to issue, the Examiner is invited to contact the Applicant's undersigned representative by telephone to resolve such issues.

Respectfully submitted,

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The roller 13a that can be brought into rolling contact with the polishing surface 12a is made of ceramics material having chemical resistance. Therefore, a substrate to be polished such as a semiconductor wafer can be prevented from being contaminated by metals or the like. The sensor 13 is mounted on the dresser head 11a via an attachment 17 so as to be vertically movable independently of the dresser head 11a.

Since the contact sensor 13 thus constructed is vertically moved in accordance with irregularities or undulations of the polishing surface 12a, the contact sensor 13 has a sliding contact surface between a fixed member and a movable member thereof. In the present embodiment, the sliding contact surface is covered with resin having chemical resistance. Therefore, the sensor 13 can be prevented from being contaminated by materials from external sources, and simultaneously contaminating external parts or surrounding atmosphere.

As described above, the sensor 13 measures a property of the polishing surface 12a while the polishing surface 12a is being dressed. A signal representing the measured property of the polishing surface 12 is outputted from the sensor 13 to the amplifier 16 and then amplified by the amplifier 16. The amplified signal is transmitted to the display device 21 in the measuring box 20. The display device 21 displays the property of the polishing surface 12a. The signal supplied to the display device 21 is inputted as measured data of the polishing surface 12a into the data collection system 31 in the recorder 30. The personal

As described above, the property of the polishing surface 12a can be monitored as shown in FIG. 4, while the polishing surface 12a is being dressed. Therefore, the two-dimensional distribution of the absolute amount of material of the polishing surface 12a which has been worn off can be related to polishing conditions or dressing conditions. Accordingly, the polishing conditions including top ring operation, and the dressing conditions can be optimized in a short time.

An actual process of measuring the polishing surface 12a will be described below. In this example, the sensor 13 is moved at a speed ranging from 10 to 200 mm/sec. The sensor 13 is mounted on the dresser head 11a, and the sensor 13 is moved along the polishing surface 12a on the turntable 12 in accordance with movement of the dresser head 11a. Thus, irregularities or undulations of the polishing surface 12a are converted into an electrical signal. The inventors have concluded from the viewpoint of experimental facilities that the speed of about 100 mm/sec of the sensor 13 is a maximum speed with allowable accuracy of the data.

The sensor 13 is moved along the polishing surface 12a at the above speed and measures the property of the polishing surface 12a. Irregularities or undulations of the polishing surface 12a are not measured at all points where the sensor 13 is moved. The measured signals from the sensor 13 are sampled every 4 milliseconds. For example, five sampling signals may be averaged to produce data representing a typical property of the polishing surface 12a in the vicinity of the

sampling points. Alternatively, each of sampling signals may directly be used to represent the property of the polishing surface 12a.

From the viewpoint of data processing, it is convenient to measure irregularities or undulations of the polishing surface 12a radially across the polishing surface 12a. However, in the present embodiment, since the sensor 13 is mounted on the dresser head 11a that is angularly movable about a center O of the dresser 11 (see FIG. 3), the sensor 13 is moved along a curved line Lc around the center O, as shown in FIG. 3, rather than along a simple straight line radially across the polishing surface 12a.

In FIG. 3, since the dressing tool 11c has a diameter smaller than the width of the dressing area B, the dressing tool 11c is angularly moved over the range of the dressing area B for dressing the polishing surface 12a of the dressing area B. However, when a dresser having a diameter that is equal to the width of the dressing area B is used, it is not necessary to angularly move the dressing tool 11c.

The personal computer 32 serves as a determination device for determining when to replace the polishing surface 12a. Specifically, the personal computer 32 compares an initially measured property of the polishing surface 12a with a measured property thereof after the polishing surface 12a is dressed several times, and determines when to replace the polishing pad of the polishing surface 12a based on the result of comparison. Thus, the personal computer 32 determines when to replace the polishing pad based on the measured data of the

Version with Markings to Show Changes Made

1. (Amended) A polishing apparatus for polishing a workpiece, said polishing apparatus comprising:

a polishing table having a polishing surface;

a top ring for holding a [the] workpiece and pressing the workpiece against said polishing surface;

a dresser for dressing said polishing surface; and

a sensor for observing a property of said polishing surface on said polishing table while [when] said polishing surface is being dressed by said dresser, said sensor being mounted on said dresser.

2. (Amended) The [A] polishing apparatus according to claim 1, wherein said sensor is for observing [property of said polishing surface is] irregularity or undulation of said polishing surface [thereof].

3. (Amended) The [A] polishing apparatus according to claim 1, further comprising a display device for displaying the property of said polishing surface observed by said sensor.

4. (Amended) The [A] polishing apparatus according to claim 1, wherein said sensor is [mounted on one of said top ring and said dresser is] vertically movable independently of said top ring or said dresser.

5. (Amended) The [A] polishing apparatus according to claim 1, wherein said sensor is to observe [measures] a property of said polishing surface over an area that is larger than an area which is to be dressed by said dresser.

6. (Amended) A polishing apparatus for polishing a workpiece, said polishing apparatus comprising:

a polishing table having a polishing surface;

a top ring for holding a workpiece and pressing the workpiece against said polishing surface;

a dresser for dressing said polishing surface;

a sensor for observing a property of said polishing surface on said polishing table while said polishing surface is being dressed by said dresser; and

[A polishing apparatus according to claim 1, further comprising:]

a determination device for comparing an initial property of said polishing surface which is observed [measured] by said sensor with a property of said polishing surface which is observed [measured] by said sensor after said polishing surface is dressed by said dresser, and determining when to replace a component of said polishing surface based on a [the] result of the comparison between the initial property and the property of the polishing surface which is observed after said polishing surface is dressed.